LISTING OF THE CLAIMS:

1. (Previously Presented) An optical device comprising a periodic multilayer structure, wherein an end surface of said multilayer structure which is not parallel to layer surfaces of said multilayer structure is used as at least one of a beam incidence surface and a beam exit surface; said periodic multilayer structure being a one-dimensioned photonic crystal.

2. (Original) An optical device according to Claim 1, wherein the length a of one period in said periodic multilayer structure with respect to a wavelength λ used is in a range given by an expression:

$$\lambda /2n_M \leq a$$

in which n_M is an average refractive index in the one-period range of said multilayer structure in the wavelength λ.

3. (Original) An optical device according to Claim 1, wherein said one period in said periodic multilayer structure is constituted by layers formed out of different materials.

4. (Original) An optical device according to Claim 1, wherein a layer varying continuously in terms of composition or characteristic is contained in a boundary between every two layers constituting said periodic multilayer structure.

5. (Original) An optical device according to Claim 1, wherein a maximum refractive index difference between a plurality of materials constituting said periodic multilayer structure is not smaller than 0.1 in a wavelength used.

6. (Original) An optical device according to Claim 1, wherein an end surface of said periodic multilayer structure on which beam is incident crosses said layer surfaces of said multilayer structure perpendicularly.

7. (Original) An optical device according to Claim 1, wherein an end surface of said periodic multilayer structure from which beam is made to exit crosses said layer surfaces of said multilayer structure.

8. (Original) An optical device according to Claim 1, wherein an end surface of said periodic multilayer structure on which beam is incident and an end surface of said periodic multilayer structure from which beam is made to exit are parallel to each other.

9. (Original) An optical device according to Claim 1, wherein said periodic multilayer structure is an optical multilayer film in which one structure formed on a transparent substrate is repeated with respect to a wavelength used.

10. (Previously Presented) A spectroscopic apparatus comprising:

an optical device constituted by a periodic multilayer structure as defined in Claim 1; said optical device having a beam incidence end surface; said optical device further having a beam exit end surface from which may be made to exit beam rays;

a means for making a mixture of various luminous flux having a plurality of wavelengths incident on the beam incidence end surface of said optical device; and

a means for detecting the beam rays made to exit from a the beam exit end surface of said optical device at different angles in accordance with said wavelengths.

11. (Original) A spectroscopic apparatus according to Claim 10, wherein: said periodic multilayer structure is an optical multilayer film in which one structure formed on a surface of a transparent substrate is repeated with respect to a wavelength used; and beam rays made to exit from said multilayer film toward said substrate are totally reflected in the inside of said substrate and taken out from an end surface of said substrate.

12. (Previously Presented) An optical device according to Claim 1, wherein the periodic multilayer structure is a one-dimensional photonic crystal having a plurality of layer surfaces, the end surface used as the beam incident surface is approximately perpendicular to said layer surfaces of said multilayer structure, and at least one surface parallel to said layer surfaces is provided as a beam exit surface.

13. (Original) An optical device according to Claim 12, wherein a length of one period is a and satisfies a condition given by an expression:

$$\lambda_o/2n_M \leq a$$

when n_M is an average refractive index in one period of said periodic multilayer structure with respect to beam with a wavelength λ_o in vacuum.

14. (Previously Presented) An optical device wherein the periodic multilayer structure is a one-dimensional photonic crystal having a plurality of layer surfaces, the end surface used as the beam incident surface is approximately perpendicular to said layer surfaces of said multilayer structure, and at least one surface parallel to said layer surfaces is provided as a beam exit surface; wherein a length of one period is a and satisfies a condition given by an expression:

$$\lambda_o/2n_M < a$$

when n_M is an average refractive index in one period of said periodic multilayer structure with respect to beam with a wavelength λ_o in vacuum; and configured wherein a condition:

$$0 < k_s \cdot \lambda_o / (2\pi \cdot n_s) < 1$$

is satisfied when k_s is a magnitude of a wave vector of a not-lowest-order coupled band in said photonic crystal with respect to said wavelength λ_o in a direction which is parallel to said layer surfaces and which does not have any periodic structure, and n_s is a refractive index at said wavlength λ_o of a medium tangent to said surface parallel to said layer surfaces and serving as said beam exit surface of said multilayer structure.

15. (Previously Presented) An optical device according to Claim 1, wherein said periodic multilayer structure is a one-dimensional photonic crystal having a plurality of layer surfaces, wherein the beam incidence surface is a surface parallel to said layer surfaces of said multilayer structure, and wherein the beam exit surface is approximately perpendicular to said layer surfaces.

16. (Original) An optical device according to Claim 15, wherein a length of one period is a and satisfies a condition given by an expression: $\lambda_o/2n_M \leq a$
when n_M is an average refractive index in one period of said periodic multilayer structure with respect to beam with a wavelength λ_o in vacuum.

17. (Previously Presented) An optical device comprising a periodic multilayer structure, wherein an end surface of said multilayer structure which is not parallel to layer surfaces of said multilayer structure is used as at least one of a beam incidence surface and a beam exit surface; wherein said periodic multilayer structure is a one-dimensional photonic crystal having a plurality of layer surfaces, wherein the beam incidence surface is a surface parallel to said layer surfaces of said multilayer structure, and wherein the beam exit surface is approximately perpendicular to said layer surfaces; wherein a length of one period is a and satisfies a condition given by an expression: $\lambda_o/2n_M < a$
when n_M is an average refractive index in one period of said periodic multilayer structure with respect to beam with a wavelength λ_o in vacuum;
configured according to a condition: $0 < k_s \cdot \lambda_o / (2\pi \cdot n_s) < 1$
wherein
k_s is a magnitude of a wave vector, for wavelength λ_o, of a coupled band as a not-lowest-order band in said photonic crystal in a direction which is parallel to said layer surfaces and which lacks any periodic structure, and
n_s is a refractive index of a medium which is tangent to said surface parallel to said layer surfaces and through which beam of wavelength λ_o enters the multilayer structure.

18. (Previously Presented) An optical device according to Claim 14, wherein said coupled band is a second coupled band from a lowest-order band.

19. (Previously Presented) An optical device according to Claim 14, wherein a condition by an expression:

$$\cos 60^\circ \leq k_s \cdot \lambda_o / (2\pi \cdot n_s) \leq \cos 20^\circ$$

is satisfied.

20. (Previously Presented) An optical device according to Claim 14, wherein said k_s satisfies a condition:

$$0.9k_l/m \leq 1.1k_l/m \text{ (m is an integer not smaller than 2)}$$

when k_l is a magnitude of a wave vector of the lowest-order coupled band.

21. (Previously Presented) An optical device according to Claim 14, wherein said medium tangent to said surface of said multilayer structure provided as said beam incidence surface or as said beam exit surface is air or vacuum.

22. (Previously Presented) An optical device according to Claim 14, wherein: said periodic multilayer structure is an optical multilayer film in which one structure formed on a transparent substrate is repeated periodically with respect to a wavelength used; and a surface of said multilayer film tangent to said substrate is provided as said beam incidence surface or as said beam exit surface.

23. (Previously Presented) An optical device according to Claim 14, wherein said one period in said periodic multilayer structure is constituted by layers formed out of different materials.

24. (Previously Presented) An optical device according to Claim 14, wherein a layer varying continuously in terms of composition or characteristic is contained in a boundary between every two layers constituting said periodic multilayer structure.

25. (Previously Presented) An optical device according to Claim 14, wherein a ratio of a maximum refractive index to a minimum refractive index of a plurality of materials constituting said periodic multilayer structure is not smaller than 1.1 in a wavelength used.

26. (Previously Presented) A spectroscopic apparatus comprising;

an optical device constituted by a periodic multilayer structure as defined in Claim 14,

a means for making a mixture of various luminous flux having a plurality of wavelengths incident on the end surface of said multilayer structure of said optical device, and

a means for detecting beam rays made to exit from a the end surface of said multilayer structure at different angles in accordance with the wavelengths.

27. (Previously Presented) A polarization separating apparatus comprising:

an optical device constituted by a periodic multilayer structure as defined in Claim 14,

a means for making a mixture of various luminous flux having a plurality of wavelengths incident on the end surface of said multilayer structure of said optical device, and

a means for detecting beam rays made to exit from a the end surface of said multilayer structure at different angles in accordance with polarized beam components.

28. (Previously Presented) The optical device of claim 1, wherein the photonic crystal comprises respective layers continuously changing in terms of refractive index, and a refractive index difference is kept between the respective layers.